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(Technology for Youth)

No 12, December 1961

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TRANSLATIONS FROM TEKHNIKA-MOLODEZHI
(TECHNOLOGY FOR YOUTH)

- USSR -

No 12, December 1961

Following is a translation of two articles from the Russian-language periodical Tekhnika-Molodezhi (Technology for Youth), No 12, December 1961. Complete bibliographic information accompanies each article.

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METEOTRON - A FACTORY OF CLOUDS

[Following is a translation of an article by L. Berne in the Russian-language periodical Tekhnika - Molodezhi (Technology for Youth), No 12, December 1961, pages 28 - 30.]

REPORTING FROM FRANCE

Artist F. Borisova

On the Lyannomezanne Plateau, two kilometers from the city of the same name, I saw the most colossal central power station ever built by man. Located under the open sky at an altitude of 6,000 meters, this air machine takes up a total space of 10,000,000 cubic meters. Its power is equal to several hundreds of millions of kilowatts, which is about 8 times more than the power consumption of all of France during the "peak" hours.

Henri Dessart is the director of the Puit-de-Domas Observatory, but he temporarily left his laboratories at Clermont-Ferrant in order to be occupied with a completely new "magic stick" which makes it possible for him to harness the clouds and even the Sun itself. This "magic stick" has a scientific name: the meteotron. Even by its name, it is evident that the meteotron has something in common with meteorology, and more precisely, with the machines being used in it.

The small collapsible building, or shed, in which the machines are housed, two black tanks, pipes, a square area fringed by a belt of burnt green foliage, rows of red tanks, three automobiles, several young people, and a man in dark glasses—all these are what first attract one's attention to the left of the road cutting across the gloomy Lyannomezanne Plateau. These are the actual pioneers and their

machine, the "tiny Meteotron".

In the words of Messr. Dessant, the meteotron is a power multiplier, and can be compared with an automobile accelerator; at a light pressure from one's foot, it yields additional dozens of horsepower. Of the meteotron, it is required that at the needed moment, it will start the "atmospheric motor" at full speed, similar to the way that this occurs in nature, sometimes tragically, as during storms and tornados.

The "atmospheric motor" is powered by the heat energy of the Sun: the solar rays falling on the ground, heat the air of the lower layers of the atmosphere, the heated air expands and, become lighter, tends to rise. The more intensive the flow of the Sun's rays incident to the Earth, the greater the amount of heated air that strives upward, similarly to the first aerial balloon that was filled specifically with hot air. But in this connection often at a height of 1,000 - 1500 meters, there forms a shield of cold air; then, under such a sealed lid, the hot air accumulates, trying to find an outlet from under it.

Sometimes the "ceiling" begins to crack under the pressure of the column of hot air, which develops a local overheating below. It so happens that the "ceiling" is disrupted, if a sufficiently deep air column forms under it. The local overheating can be the result of the burning of grass, forest fires, or most often of the intensive reflection of solar rays, falling on a brighter surface. In this case, the hot air rises quickly through the crack that has formed. An example of such a phenomenon is the recent storm in Evrais, Normandy.

Burning a ton of gas oil per minute (diesel fuel), the meteotron also develops a local overheating of the air, to which it expends around 700,000 kilowatts, i. e. the power of a large heat-power plant. This is what force is needed to break through the stable coverings of cold air! Millions of cubic meters of air, heated for a day by the Sun, rush through the "tube" formed in this way. After this, cumulus clouds appear, followed by clouds bearing up to 300,000 tons of water. The condensation of this water requires in round numbers 100,000,000 kilowatts and yields precipitation that can last for several hours. Indeed, this is a real marvel! Here on Earth is a machine, expending 700,000 kilowatts in 3 minutes, and in the sky is a "motor" yielding 100,000,000 kilowatts for 4 - 5 hours. The cost of this energy in all amounts only to the cost of 3 tons of gas oil, hundreds of nozzles, 700 meters of pipes, and a motor pump.

Henri Dessant's basic idea consists in that one should be able to use at will the vast reserves of power being developed by the Sun over our heads. If until now the meteorologists did not desire to work with the wandering clouds, now they have the opportunity of creating clouds when and where they find this necessary. Hence, there will soon begin the systematic use of the unlimited reserves of solar energy. No matter how much promise is offered by all possible kinds kinds of solar mirrors, solar boilers, batteries of photo- or thermo-elements, they are nevertheless only collectors of pitiful bits of solar energy, equal in force to several hundreds of thousands of kilowatts. At times, much enthusiasm is evoked by the invention of some device for heating with the aid of solar rays. But the original marvel is to know how to collected in a predesignated region groups of clouds and to force rain to fall over reservoirs arrayed in the form of cascades. This will furnish the possibility of constructing entire chains of hydroelectric stations and to create a sea of fresh water in any valley. Such are needed by our industrial and agricultural regions.

Having realized the unachievable dream of wizards, of the "commanders of clouds", the scientists will be able to eliminate the untimely and unwanted rains at vacation areas. As was predicted by Henri Dessant, instead of allowing the rains to fall over the Banert-de-Bigorre, they will concentrate storms over Oredon Lake, as a result of which it will be transformed into a reserve of electrical power.

All this is a dream of the future, but undoubtedly of the near future, and it is specifically promoted by the enthusiasm of the "hermits" of the Lyannomezanne metectron. I think that Fermi, having noted from the trembling of the indicator needles of the first atomic reactor, the appearance of electric current as the result of the bombarding of neutrons, experienced a feeling of joy similar to that which I observed on the face of Henri Dessant when he, in demonstrating his experiment, showed to us a suddenly appearing large cloud in the blue sky. It appeared as quickly as a picture appears in a developing tray in a photographer's laboratory. At the same moment, into the formed cloud, there was shot a rocket equipped with a device for counting the water drops. This unusual detector was designed by the young researcher, Serge Godart. His device travels 10 km in the clouds, and then returns to Earth to provide the scientists with a "report" of what it has seen. Together with the hot air from the metectron, into the sky there rises a special

parachute which was developed by Dessant's son. For reasons of great disturbances within the air mass, the parachute continually vibrates and sways. The radar antenna follows the "dancing" parachute, and a recording device attached to it provides a graphic portrayal of the jolts, i. e. the pattern of the storm activity prevailing within the cloud. At this very same time, viewing tubes and movie cameras at the Pic-du-Midi Observatory, located at 3,000 meters above sea level, conduct observations of the cloud that has formed. From now on, the astronomers will have the chance, without leaving their observatories, of diverting a little attention to our planet, and of making for the first time an actual report on the genesis and life of a cloud. All of the observations collected are subjected to scientific processing, are given their own interpretation and will constitute a basis for the recognition of the clouds' nature. The cloud is measured, is recorded, and is thoroughly analyzed from the viewpoint of its advantages and disadvantages. However, a cloud will be considered quite suitable if it is capable of providing rain that has long been waited for; it will be considered poor if it carries a lot of hail in it; it is necessary to force it to yield its water reserves prior to when it can inflict damage to man. However, it should be kept in mind that man is not powerless in this respect. He can attain a favorable outcome by reducing the amount and the size of the hailstones. In the worst case, soft hail will fall, and in the optimum one, rain will fall.

At night from the 9th to the 10th of August, 1959, a severe storm passed over Bordole, and the hail destroyed its vineyards. From the time of this elemental catastrophe, Henri Dessant began to study the conditions of hail formation. At present, he can already boldly assert that the "opponent" is by no means as unconquerable, because one can (even from the Earth) exert an effect on hail-bearing clouds by sowing them with silver iodide particles, which obstruct the formation of large hailstones of several decigrams in size.

Agriculture and the enterprises producing electric power will be the first to use the results of the scientific research being conducted on the gloomy Lyannomezanne Plateau. But these studies will unfold before us other, even more surprising possibilities. For example, it is not excluded that life will be returned to a number of deserts and they will be transformed to flourishing regions, as they were in the remote past. In certain regions of the Sahara, we can observe entire groups of clouds which seem to hang over the weary travelers wandering among the burning rocks and the sandy dunes. Oh, if it were only within man's power to force

these clouds to yield to the Earth thousands of tons of water which they carry in themselves!

Once the Swedish scientist Thor Bergeron stated the bold assumption regarding the idea that this would be quite realizable. No one believed him, and he preferred to occupy himself in the quest of hypothetical subterranean seas. But he continued to stand behind his beliefs. He established that the clouds over the Sahara Desert do not yield rain because they are not located at a sufficient height for this. Most often here they rise to a height where the temperature decreases in all only to -30° , and at such a temperature, a cloud does not yield rain. In order for rain to fall, the peak of a cloud should rise to a temperature of -35° . Hence the problem consists in jolting the cloud from beneath and forcing its top to rise somewhat higher. Really, this is just what the meteotron does! It is specifically capable of forcing the column of hot air to rush upward, and by the same token, to help the cloud grow to the height need for the formation of rain.

In the torrid regions of the Earth where the Sun shines quite intensively (such as in the Mediterranean Basin), it is quite possible to use the meteotron for changing the cycle of the use of water. Usually in these countries, the water absorbed by plants is partly evaporated by them and always disappears in the blue of the sky, since rain clouds can not form in it. This means that here the water can be used only once. What if we set up a meteotron in such a locality? Really, it can force the evaporated water to form rain clouds, the reservoirs of water, which man will very quickly learn to control. The Lyannomezanne meteotron will soon provide all the needed information relative to the number of possible repeated uses of water by plants. In several years in the technology of meteotrons, it will be easy to use nuclear energy, which will become cheaper; the meteotron, having become accessible in cost, will be used by the large agricultural groups. It is also possible that in the Sahara, several dozens of "climate factories" consisting of meteotrons will return to its limitless deserts the chestnut forests of yore and make them just as flourishing as they were 5,000-6,000 years ago.

Of course, we will find people who will use the meteotron, not as a means for harnessing the clouds, but will use its other qualities. The columns of hot rising air can pull masses of smog along with them.

Let's assume that near Paris, several meteotrons have been set up. As soon as the health service reports that the content of carbon monoxide in the air has become dangerous, it will be sufficient to fire up the meteotrons so that this "air pump" would go into action and in several minutes would purify the air around Paris. The same function could be performed by meteotrons located next to atomic centers.

Finally, we can point to the possible use of the meteotron as an "elevator" for raising parachutists who, being in the column of rising air with their parachutes opened, would be pushed up for several minutes into the upper "floors" of the troposphere at a height of 5,000-6,000 meters.

Although it is only of recent development, the Lyannomezanne meteotron has already acquired wide repute. The International Conference of Physicists, working on the investigation of atmospheric phenomena that took place at the beginning of June in Hamburg, adopted a resolution concerning the conduct on the Lyannomezanne Plateau of their annual activities in 1963.

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FIVE STEPS INTO THE EMPIRE OF PLUTONIC THEORY

[Following is a translation of an article by I. Bobrov, Scientific co-worker, in the Russian-language periodical Tekhnika - Molodezhi (Technology for Youth), No. 12, December 1961, pages 34 - 36.]

In the division of the universe among the gods, the underwater kingdom was given to Neptune and the underground one fell to the lot of Pluto. At the entrance to his possessions, the grim Pluto placed the huge three-headed dog Cerberus. This fierce guard was to protect the secrets of Hades against the simple mortals. But a challenger was found - this was the famous strong man Hercules, who vanquished the ferocious beast and fought Pluto singlehanded.

In this ancient myth are reflected the naive concepts of that epoch concerning the secret world located beneath our feet, and the dreams of its conquest by man.

Millennia went by. The legends were replaced by the scientific concepts of geology and geophysics. In quest of coal and uranium, gold and diamonds, with the aid of the steel "moles" built by him, man dug back and forth in the cover to the "kingdom of Pluto" in huge underground corridors. The steel drills, equipped with diamond jaws, bore ever deeper into the earth. The Earth's folds located farther from the surface are inspected by geophysicists with the aid of waves from artificial earthquakes, the reflections of which are detected by sensitive devices, i. e. by seismograms. A study of the ejected volcanic gases, steam and lava, the identification of their composition and of the relative content of chemical elements supplements the extent of our knowledge regarding the structure of the earth's interior. Nevertheless, until now the subterranean world has been enveloped in an aura of mystery.

What do we know about the "residence of Pluto"?

ENIGMATIC NETHER WORLD

The most detailed data on the structure of the Earth are furnished us by the observations of the propagation of seismic waves.

In 1909, the Yugoslav geophysicist A. Mohorovicic studied an earthquake in the Balkans. He found that the seismic waves at a depth of several dozens of kilometers undergo a reflection and refraction. Perhaps this indicated that below this level, the material comprising the Earth has other properties. Later other researchers demonstrated that such changes exist everywhere. The level of such changes was called the Mohorovicic boundary. The layer above this boundary was called the Earth's crust. The subjacent layer with a thickness of 3,000 kilometers was called the mantle. The mantle surrounds a nucleus with a radius of 3,400 kilometers located at the center of the Earth. Thus in its structure, the "underground empire" is reminiscent of an egg: the yolk is the core, the white is the mantle, and the shell is the Earth's crust. The surface of a fine film between the shell and the white corresponds to the Mohorovicic boundary.

But we by far can not leave the Earth's structure to this one understanding of the pattern. It is necessary to clarify what each layer represents, especially the mantle, containing 84% of the volume of our planet.

It would appear that nature herself provides an answer to this question. Actually the hot rivers of lava flowing from volcanic cones give one the idea that the Earth's crust is a raft floating on a sea of molten magma. Really, wherever the fiery breath of the Earth erupts, there is a real hell: the upper part of the mantle is heated to 1,000.. 1,500°! At the boundary between the mantle and the core, the temperature reaches 2,000 - 4,000°. Under such heat, any silicate and aluminosilicate rocks, of which the mantle evidently consists, should convert to a liquid state. A seismological probing of the "inner state" of the Earth showed that the mantle material at the same time is 2 - 4 times harder than the very hardest steel.

What is the mantle like? What form is it in, and of what is it composed? The possibility is not excluded that the matter, compressed by millions of atmospheres which prevail in this zone, acquires some special plastic properties. Until this day, this remains the subject of scientific discussions. Actually, it is just under the crust that

there is an arena of the engagement of titanic forces, which in the twinkling of an eye are able to transform the quiet of a peaceful city to the horrors of an earthquake or the nightmare of a volcanic eruption. The activity of the same "laboratory" also governs the course of accumulation of mineral resources.

The core of our planet hides even greater secrets. Moreover, what can we say about the core, which is miles and miles away from us! Even the Earth's crust on which we walk is still far from fully studied. Until now it has been unclear why there are earthquakes, why mountains upwarp, and the continents sink. Our data are also scant regarding the formation of minerals.deposits.

The famous Russian cosmonaut Ghermann Titov viewed the Earth's surface from the giddy height of 250 kilometers through the window of a Soviet spacecraft. At the same time, no one has yet penetrated even a tenth of this distance into the "underground cosmos". Having descended to the bottom of the deepest mine shaft in the world, we are in all only 2.5 kilometers from the Earth's surface. A limit twice as great has been reached by the drillers in the Soviet Apsheron Peninsula. Nevertheless, the thoroughly studied layer of the Earth's crust on the scale of our planet is no more, relatively speaking, than the layer of paint on a globe. Beyond this is the unknown.

But why has the scientific world met with lively curiosity the report regarding a bold effort to penetrate the Earth's crust?

FIVE SEVEN-MILE STEPS

It was now the turn for the "underground cosmos". On 25 August 1961, at an expanded session of a meeting held by the Ministry of Geology and Conservation of Resources of the USSR, proposals from scientists were examined. These dealt with the drilling of 15 boreholes to a depth of 10 - 15 km in various regions of our country. These were literally to be seven-mile strides into the "Kingdom of Pluto"! As yet the points had only been roughly chosen, with the idea being that the cutting of the holes would provide a complete picture of the deposition of all types of rocks forming the Earth's crust: sedimentary, granites and basalts.

As is hypothesized, the lower stratum of the Earth's crust is the basaltic layer. The thick basaltic cover is the support on which rests the granitic layer, covered by

a mantle of sedimentary rocks. It is true that the Earth's crust does not always have a three-layered "architecture". For instance, the ocean floor consists of a basaltic support and a very thin layer of sedimentary rocks. The granites, comprising from $\frac{1}{2}$ to $\frac{1}{3}$ of the rocks of the continental massifs, extrude (outcrop) directly to the surface in certain places. To be sure, the thickness of the layers is not uniform everywhere. This is why we are faced with much work in the final explanation of the geographic points where the operations will be undertaken.

The friable sedimentary cover--this is a sponge, saturated with all possible kinds of minerals: oil and coal, combustible gases and salt, iron and aluminum, zirconium and titanium, gold and platinum--this is far from a complete list of those riches that are concealed in the upper stratum of the Earth's crust. The drilling of borehole No. 1 is planned in a region where the thicknesses of the sedimentary rocks are the greatest. Obviously, this will be some oil-bearing region. Drilling to a depth of around 14 km will permit the geologists to explore new, as yet inaccessible deposits of oil, and to establish the lower limits of their occurrence. The century-old argument may be silenced between the proponents of the hypothesis of the oil's organic origin, even advanced by M. V. Lomonosov, and those who consider that the oil was formed from mineral substances (the viewpoint of D. I. Mendeleev). It is not excluded that at high pressure and temperature in the interior of the Earth's crust, there could develop a synthesis of organic matter from nonorganic, leading to the formation of "black gold". If this be so, then the deeper we drill, the more oil we shall find!

The depth of borehole No. 2 will be about 15 km. The hole will open the most ancient granites of our country, which, according to the testimony of geochronology, are over 3½ million years old. What is of interest to scientists here? How continents are born, how the evolutionary processes proceed in the upthrust rocks, leading to the formation of the granitic layer--these and other key questions of geology will be partly solved by the cutting of the Karelian borehole.

Still another important site for very deep drilling will be some mining region, let us say, the Urals. Drilled in a mountain range, borehole No. 3 will reach its very roots. It will give geologists information on the richest underground reserves of copper and of other metals. It is assumed that the drilling will pass through remnants of subterranean seas of molten magma. As a result, the causes for the origin of foci of magnetism will be clarified.

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From borehole No. 4, the drilling of which is earmarked for a region where the basaltic layer comes closest to the Earth's surface, the geologists expect information on the nature of the basaltic support of the continent, and on how and why there occurred a stratification of the crust into granites and basalts, how lodes of metals were formed from the fusions and vapor-water solutions, by what route the elements rise from the depths to the Earth's surface, and many, many other facts. Entire novels will be written about this engaging journey into the unknown.

However, the most enticing route to the "nether regions" is to be followed (laid) by borehole No. 5. It is allotted a site where the layer of the Earth's crust is the thinnest on land. Having pierced the basalt, the probe will cut through the Mohorovicic boundary. Here, sealed off by the basalt layer, the enigmatic mantle is concealed. On that side of the conquered boundary, there will be found the graveyard of many theories regarding the inner structure of the Earth. These theories have been constructed on the quaking sands of indirect evidence. Finally, man will extract from under the crust a piece of the mysterious matter from the mantle. The doubts will disappear, having yielded to accurate scientific knowledge.

Having received samples of the material comprising all the layers of the Earth's crust, the scientists will conduct a physical and chemical analysis of them. The measurement of the radioactivity of the various layers will permit us to discover whether our planet has cooled off or has heated up. A study of the isotopic structure of the minerals will fill in the "Age" column in the history of the Earth's crust and the mantle. Forecasts of the composition and state of all the Earth's layers, starting from the crust and ending with the core, will become more reliable. It will be clarified whether the location of the Earth's magnetic pole has shifted. Finally, we will be able to compare the composition of the mantle's material with that of meteorites. All this will help us to recreate the continuous pattern of the Earth's geologic development over many millions of years.

At a great depth in the Earth's crust, the scientists will find an inexhaustible source of heat within the Earth. Up to this time, these colossal resources of energy have remained untapped. Actually, to be able to harness the geothermal energy will make it possible to transform winter to summer, the tundras to subtropical regions, will ignite the sun of electrical power and harness the horsepower of electric motors, brought to life by the steam from the underground

"central heating plants". Such potentialities offer man the mastery of the "thermal machine" of the Earth, and this mastery will begin with the direct, face-to-face, familiarity with the underground "Hades".

Many obstacles will confront the scientists in the accomplishment of this grandiose program. The "Kingdom of Pluto" preserves faithful "Cerberus"-like characteristics: tremendous pressures, temperatures running to hundreds of degrees, in the zone of which the soil water, rushing into the borehole, will turn to steam, to take on the destructive force of an explosion. This is far from all. The drilling technology permits such standards of distortion of the boreholes that a very deep probe, gradually being deflected, can bend so much that it will project its "nose" to the Earth's surface. It is impossible to list the difficulties that will have to be overcome by the modern Hercules in their duel with Pluto. But the scientists are betting that the powerful Soviet technology is capable of handling even more daring projects.

It is difficult to find anything comparable, in scope of scientific problems, in the world practice of mastering the Earth' depths. Even the famous American "Mohole" project, the name of which is again linked with Mohorovicic, is forced to be limited to more modest goals. Nevertheless, it is interesting how the Americans are preparing to reach the Mohorovicic boundary.

THE ROUTE IS PASSING THROUGH THE "DOMINIONS OF NEPTUNE"

On the blue waves of the Pacific Ocean, along the western coast of Mexico, a huge vessel is anchored; its deck has a structure erected on it that is reminiscent of the Eiffel Tower. This is the "Cuss-1", a floating drilling station for the test boring of the sea floor. It is intended for testing the equipment and techniques which are proposed for future use to accomplish the "Mohole" project. The depth of the gulf at the place of drilling is 3.5 km. The question arises, why drill into the Earth by such a method?

The fact of the matter is that the ocean floor is the thinnest part of the Earth's crust. The continents have pressed down so much on the basaltic support that under their weight, the Mohorovicic boundary moved away 30 - 40, and in places 70 km from the Earth's surface. At the same time, it is close at hand in the regions of certain islands. It is separated from the ocean floor by a basaltic layer several

kilometers thick, and by a superjacent layer of sedimentary rocks several hundreds of meters thick. It is true that there are many kilometers of water lying above the ocean floor, but really the "Kingdom of Neptune" is much more pliant for drilling than is the "Kingdom of Pluto".

Of course, the use of the "Dominions of Neptune" as a beachhead for winning the struggle with the "Kingdom of Pluto" creates known inconveniences. The drilling must be conducted from an unanchored vessel, the stationary state of which is assured by powerful diesel engines mounted on board on four sides of the ship. The position of the ship is regulated by 4 or 5 buoys, being held by an anchor cable around the ship at a depth of many tens of meters. The buoys are equipped with sources of sound pulses. The electronic equipment on board the ship picks up the signals from afar and converts them into commands to the helmsman. The helmsman at a central control post regulates the direction and operating speed of the rudder engines, so that the vessel will always be kept above the hole in the preset position in spite of the ocean currents. This is quite important. To be sure, the hole is separated from the ship--only the drill itself connects the vessel with the ocean floor. Therefore, if the drill is pulled out of the hole, it will be impossible to find it again. This is why all the operations on the measurement and taking of samples are conducted with the aid of instruments lowered into the borehole on a line or cable.

The drilling operations so far seem to be repetitions. But the preliminary results already obtained are of definite interest. A study of the ocean floor permits us to conclude that the soft bottom deposits were formed around 30 million years ago in a geologic period which is called the Miocene. Recently the National Academy of Sciences of the U.S. sent the USSR Academy of Sciences a sample of a basalt core collected on 2 April 1961 during drilling at 3,570 meters from on board the "Cuss-1" at the 186th meter of the hole. Having reached the basaltic support, the scientists have encountered new difficulties. It is necessary to have a drill capable of piercing the hard basaltic layer.

The French engineers have already developed and tested a model of a turbodrill for the "Mohole" project. Its head revolves at 750 revolutions per minute instead of the usual 40 rpm. At present, a new vessel is planned for mounting the drilling stand. Apparently, it will take several years before we can get the first samples of the mantle.

The cooperation of scientists from various countries will hasten the conquest of the "Kingdom of Pluto".

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